WP2706 (Preliminary)

5.5V,7A Low R_{DSON} Load Switch witch Current Monitoring

1. General Description

The WP2706 is a load switch to provide 7A load protection covering 0.5V to 5.5V voltage range. With the small R_{DSON} in tiny package, WP2706 provides very high efficient and space saving solution in notebook and tablet or other portable devices application.

The WP2706 equipped with the very accurate current monitor function. The gain of the current monitor can be scaled to different applications. With the soft start function, the WP2706 can avoid inrush current during circuit start up. WP2706 also provides different functions, like programmable soft start time, output discharge function, OCP and thermal shutdown features.

Tiny QFN-12 (2mmx2mm) of WP2706 is available in space saving package.

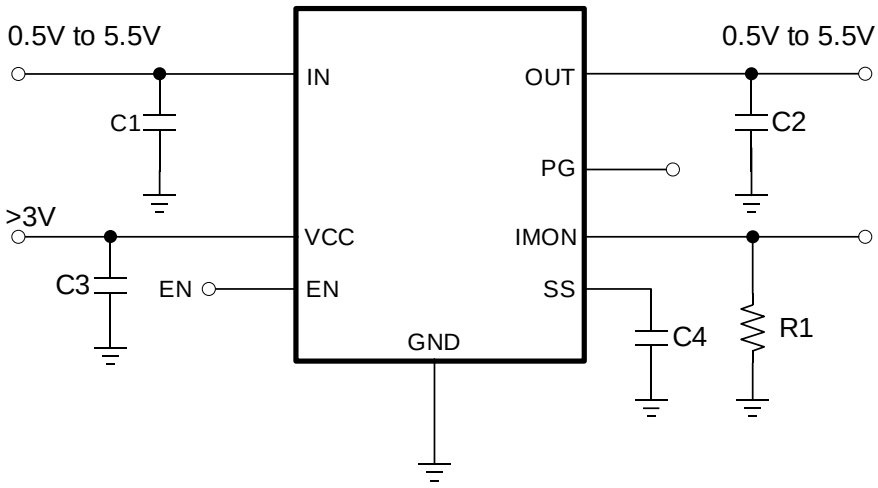
2. Features

- Large VIN Range from 0.5V to 5.5V
- <1μA Shutdown Current
- Integrated 10mΩ Low RDSON FETs
- Typical 7A Load Current Range
- Output Current Monitoring Accurate High to 3%
- Push Pull PG Indicator
- Adjustable Start Up Slew Rate
- Output Discharge Function
- Thermal Protection
- Small QFN-12 (2mmx2mm) Package for Space Saving

3. Applications

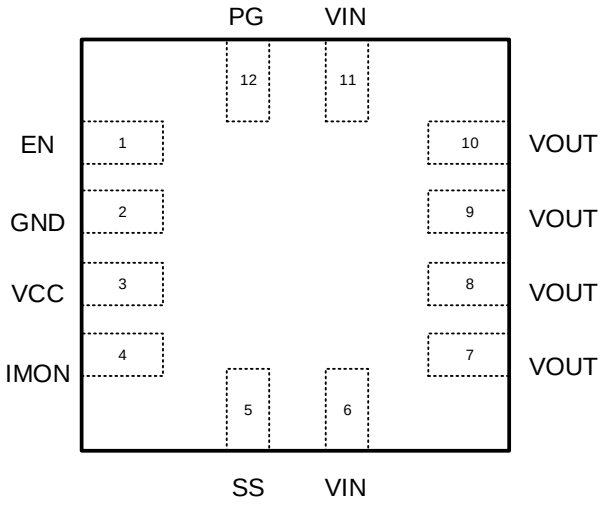
- Notebook and Tablet Computers
- Portable Devices
- Solid State Drivers
- Handheld Devices

4. Typical Application



5. Pin Configuration

(Top View)



QFN-12(2mm x 2mm)

6. Pin Description

PIN NUMBER	PIN NAME	I/O	PIN FUNCTION
1	EN	I	Enable Input. Pulling this pin below the specified threshold shuts the chip down.
2	GND	-	Ground.
3	VCC	I	Supply Voltage to the Control Circuitry.
4	IMON	O	Output Current Monitor. Provides a voltage proportional to the current flowing through the power device. Place a resistor to ground to set the gain.
5	SS	O	Soft Start Pin. An external capacitor connected to this pin sets the slew rate of the output voltage soft start period.
6,11	VIN	I	Input Power Supply.
7,8,9,10	VOUT	O	Output to the Load.
12	PG	O	Power Good Pin. Push-Pull output.

7. Absolute Maximum Ratings[1]

Over operating free-air temperature range (unless otherwise noted)

PARAMETER	RATING	UNIT
IN	-0.3 to 6.5	V
VCC	-0.3 to 6.5	V
OUT	-0.3 to 6.5	V
EN, SS, IMON	-0.3 to V_{CC} + 0.3	V
Junction Temperature	150	°C
Power Dissipation (QFN2x2 -12)[2]	1.6	W
Junction-to-ambient Thermal Resistance(θ_{JA})	80	°C/W
Junction-to-case Thermal Resistance(θ_{JC})	16	°C/W
Storage Temperature	-55 to 150	°C
Lead Temperature (Soldering, 10 sec)	260	°C
ESD(HBM)	2000	V

NOTE1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE2: The maximum allowable power dissipation is a function of the maximum junction temperature $T_{J\,(MAX)}$, the junction-to-ambient thermal resistance θ_{JA}, and the ambient temperature T_A. The maximum allowable continuous power dissipation at any ambient temperature is calculated by $P_{D\,(MAX)} = (T_{J\,(MAX)}-T_A)/\theta_{JA}$. Exceeding the maximum allowable power dissipation will cause excessive die temperature, and the regulator will go into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage.

8. Recommended Operating Conditions

SYMBOL	PARAMETER	MIN	MAX	UNIT
V_{IN}	Input Voltage	0.5	5.5	V
V_{CC}	Supply Voltage	3	5.5	V
V_{OUT}	Output Voltage	0.5	5.5	V
T_J	Operating Junction Temperature	-40	125	°C
T_A	Operating Ambient Temperature	-40	85	°C

9. Electrical Characteristics

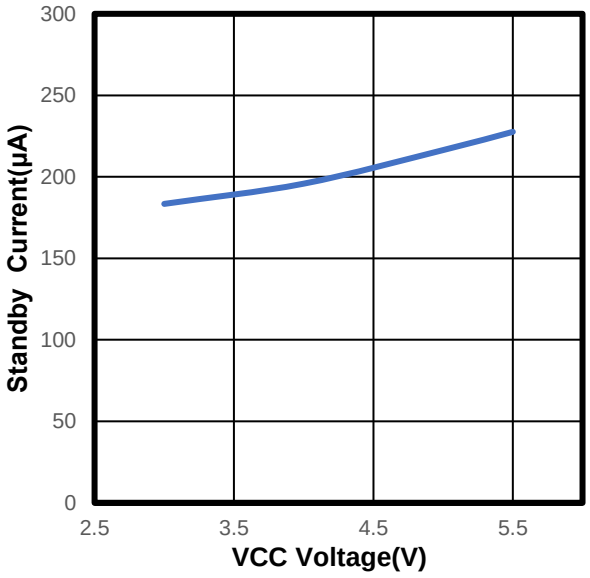
(V_{IN} = 3.6 V, V_{CC} = 3.6 V, T_A=25°C, unless otherwise noted)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP.	MAX	UNIT
Input and Supply Voltage Range						
V_{IN}	Input Voltage		0.5		5.5	V
V_{CC}	Supply Votage		3		5.5	V
Supply Current						
I_{OFF}	Off State Leakage Current	V_{IN}=5V, EN=0			1	μA
I_{STBY}	V_{CC} Standby Current	V_{CC}=5V, EN=0		0.1	1	μA
		V_{CC}=5V, Enable, No Load		220	300	
Power FET						
$R_{DS(ON)}$	Switch on-resistance	V_{CC}=5V		10		mΩ
		V_{CC}=3.3V		12		
Thermal Shutdown and Recovery						
T_{STD}	Shutdown Temperature			155		°C
T_{HYS}	Hysteresis			40		°C
Under Voltage Protection						
V_{CC_UVLO}	V_{CC} Under Voltage Lockout Threshold	UVLO Rising Threshold		2.6	2.8	V
V_{UVLO_HYS}	UVLO Hysteresis			200		mV
Soft Start						
I_{SS}	SS pull-up Current	Fixed slew rate		9		μA
Enable						
V_{ENH}	EN Rising Threshold		1.3	1.5	1.7	V

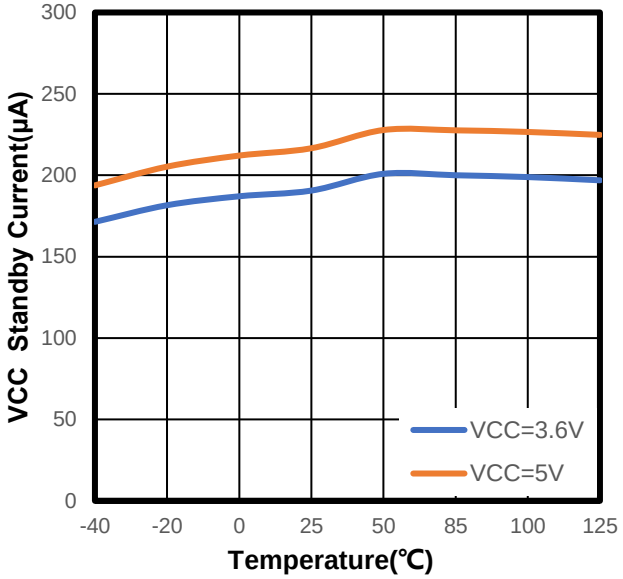
SYMBOL	PARAMETER	TEST CONDITIONS		MIN	TYP.	MAX	UNIT
V_{EN_HYS}	EN Hysteresis				300		mV
IMON							
I_{OUT}	Current Limit	R_{IMON}=50kΩ		1.54	1.64	1.74	A
Current Monitor Accuracy		V_{IN}=3.6V	I_{OUT}=3.75A		45.37		μA
			I_{OUT}=3A		36.59		
			I_{OUT}=1.5A		18.3		
		V_{IN}=1.2V	I_{OUT}=3.75A		46.65		
			I_{OUT}=3A		37.3		
			I_{OUT}=1.5A		18.66		
Discharge Resistance							
R_{DIS}	Discharge Resistance				200		Ω
PG							
V_{PG_R}	Power Good Rising Threshold	Voltage gap between V_{OUT} and V_{IN}		110	150	250	mV
V_{PG_HYS}	Power Good Hysteresis				50		mV
T_{PG_D}	Power Good Delay				90		μs
V_{PG_H}	Power Good High	V_{CC}=3.3V		3.2			V
V_{PG_L}	Power Good Low	Sink 1mA				0.2	V

10. Typical Performance Characteristics

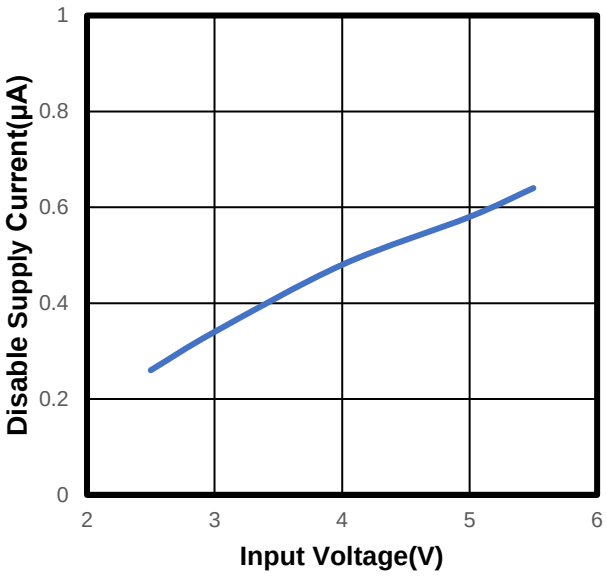
(V_{IN} = 3.6V, V_{CC} =3.6V, T_A=25°C, RIMON=10.5kΩ, unless otherwise noted)



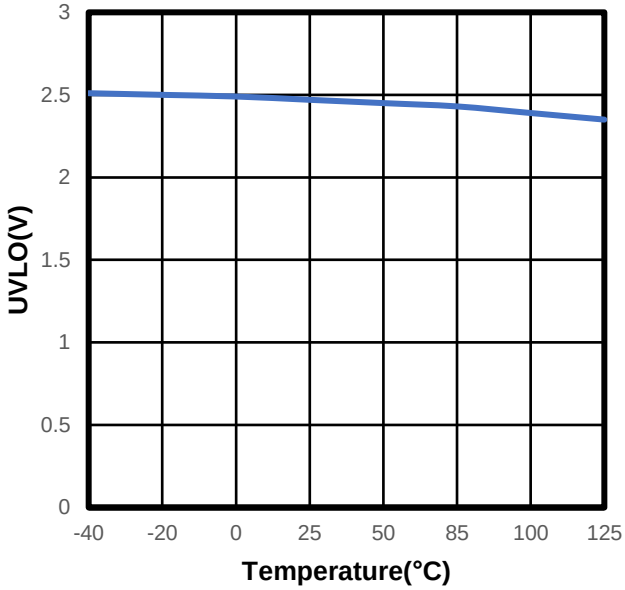
V_{CC} Standby Current vs. V_{CC}



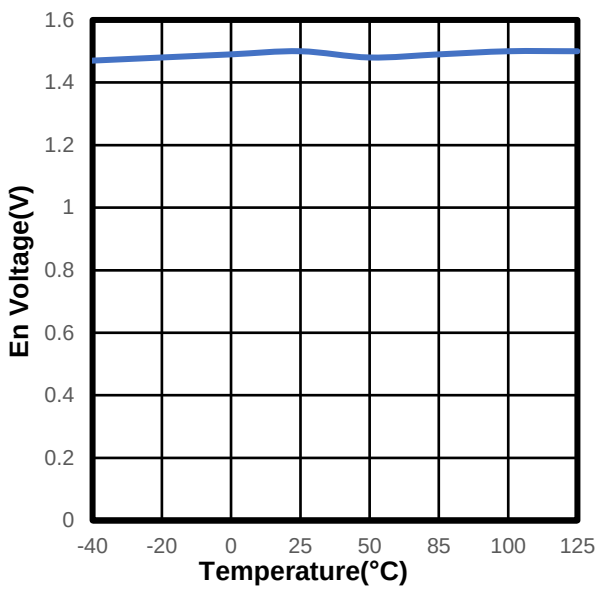
V_{CC} Standby Current vs. Temperature



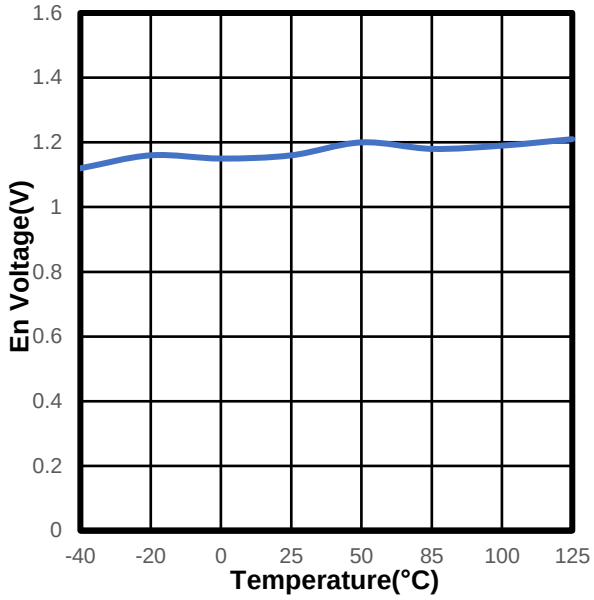
Disabled Supply Current vs. Input Voltage



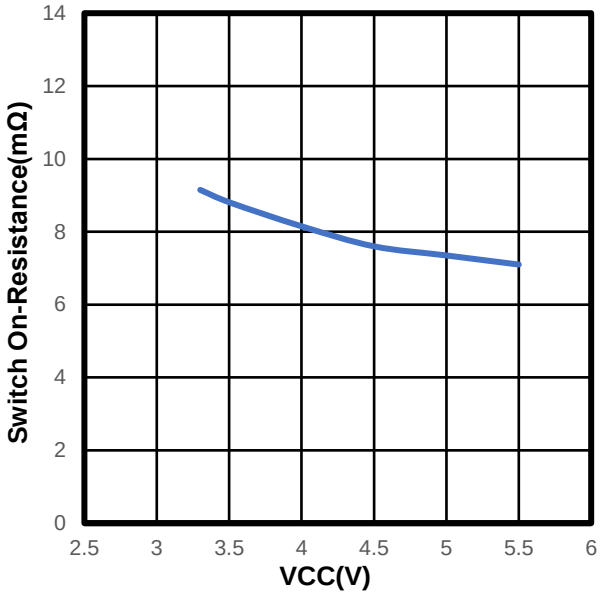
VCC UVLO Rising Threshold vs. Temperature



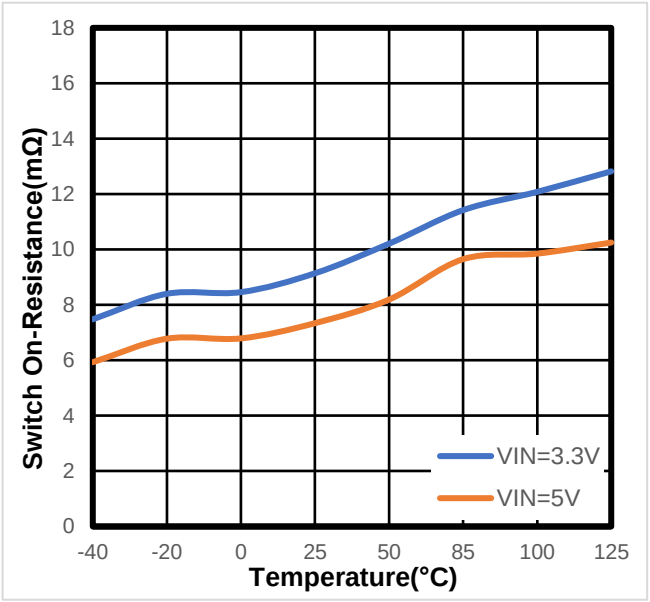
EN Rising Threshold vs. Temperature



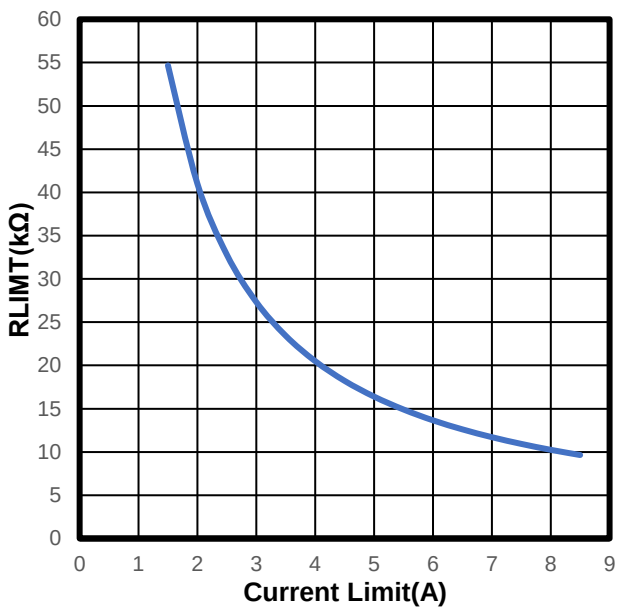
EN Falling Threshold vs. Temperature



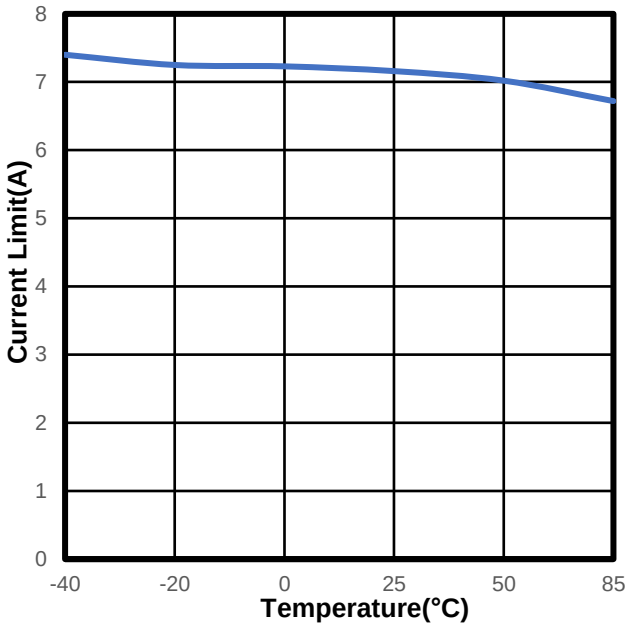
R_{DSON} vs. V_{CC}



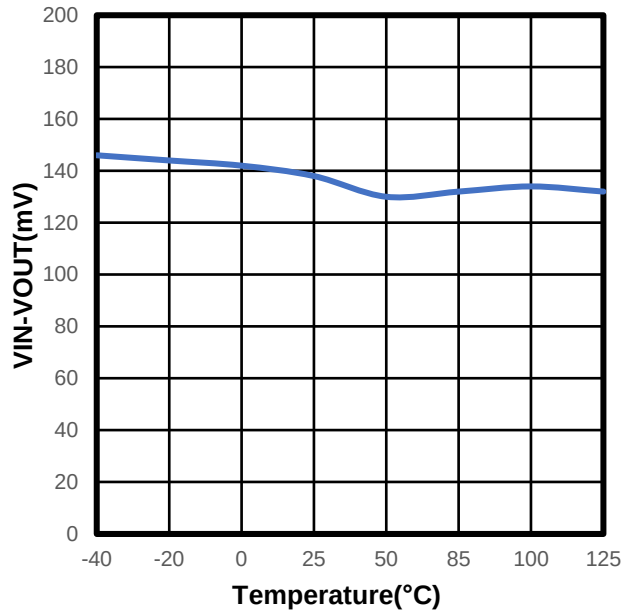
R_{DSON} vs. Temperature



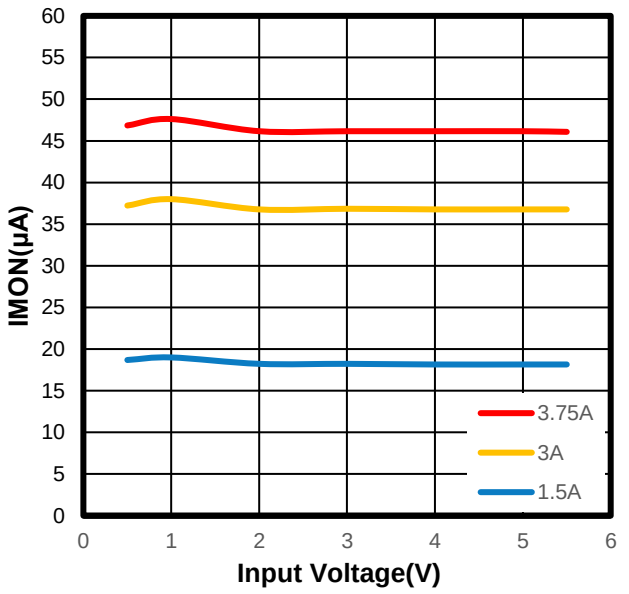
Current Limit vs R_{Limit}



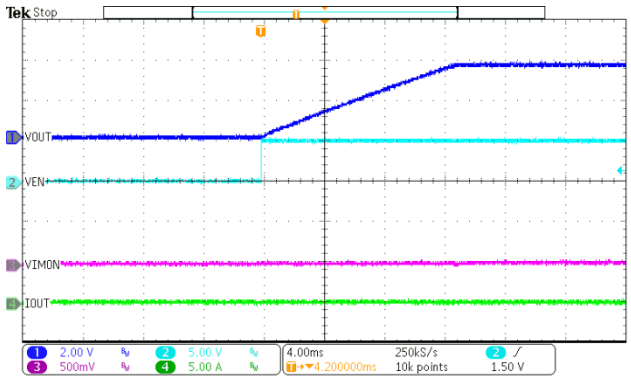
I_{LIMIT} vs. Temperature



PG Rising Threshold vs. Temperature

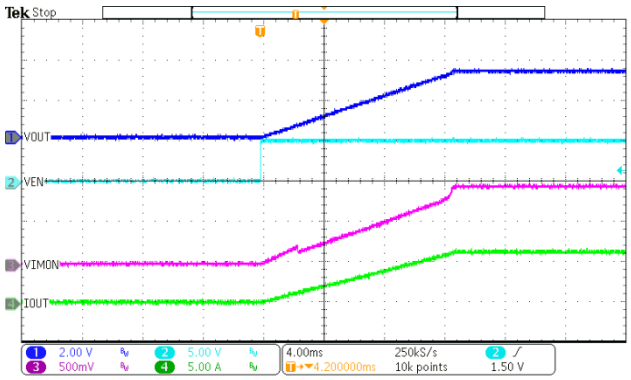


IMON Accurancy vs. V_{IN}



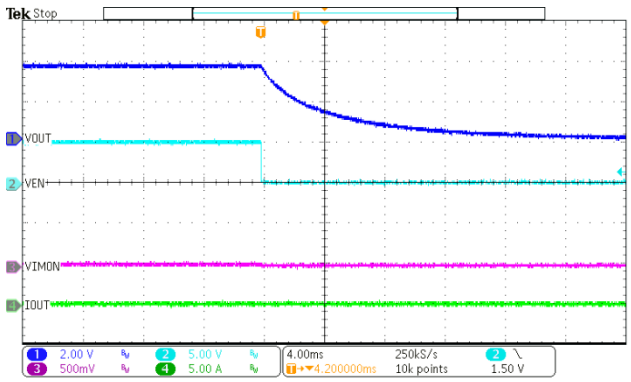
Enable Startup

V_{IN}=3.6V, V_{CC}=3.6V, No load



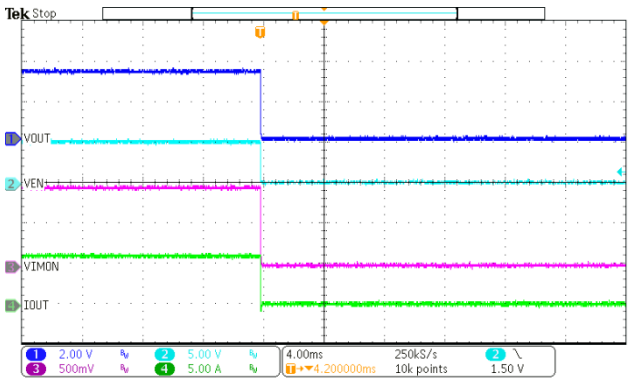
Enable Startup

V_{IN}=3.6V, V_{CC}=3.6V,7A load



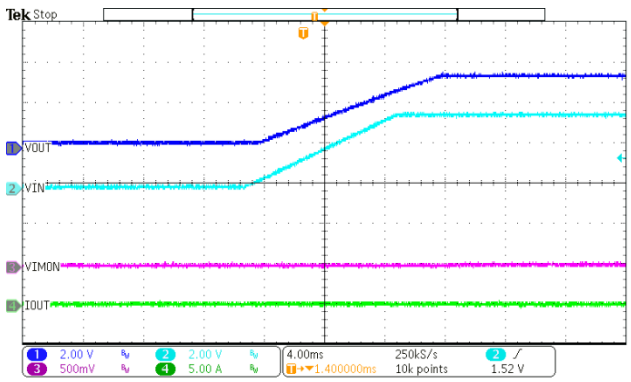
Enable Shutdown

V_{IN}=3.6V, V_{CC}=3.6V, No load



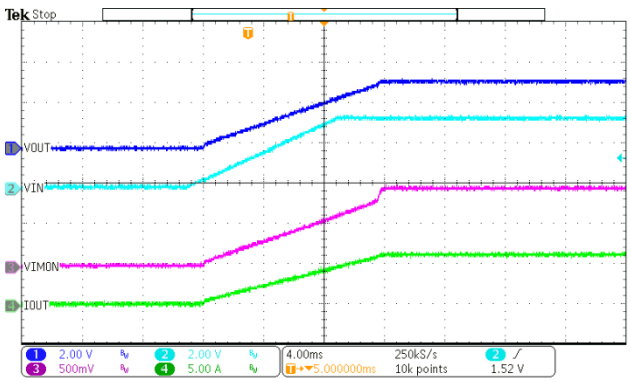
Enable Shutdown

V_{IN}=3.6V, V_{CC}=3.6V,7A load



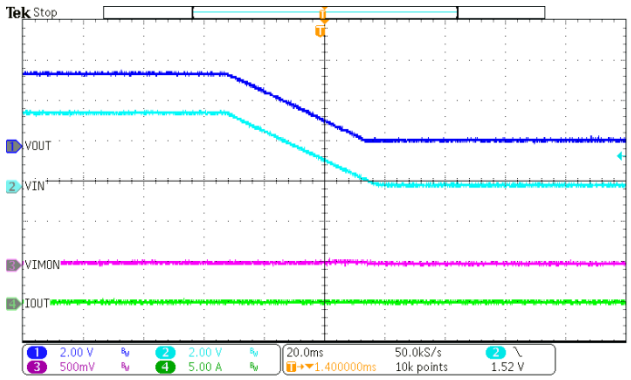
Power Up

V_{IN}=3.6V, V_{CC}=3.6V, No load



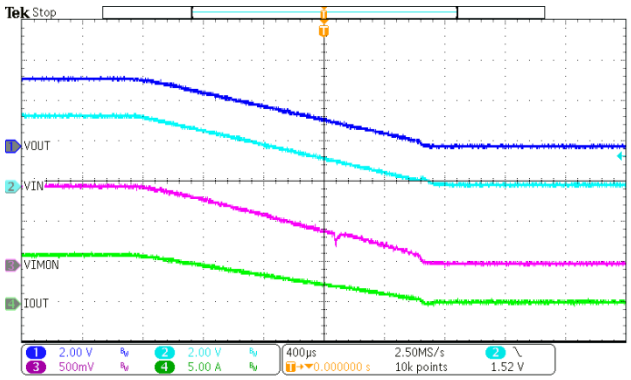
Power Up

VIN=3.6V, VCC=3.6V, 7A load



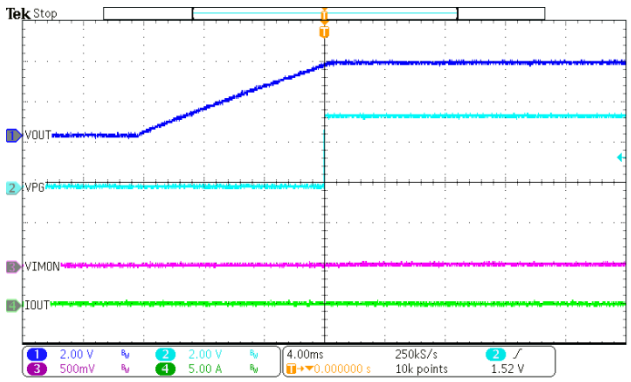
Power Down

V_{IN}=3.6V, V_{CC}=3.6V, No load



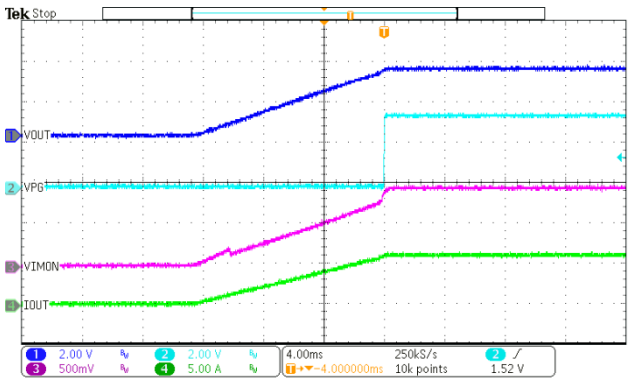
Power Down

V_{IN}=3.6V, V_{CC}=3.6V, 7A load



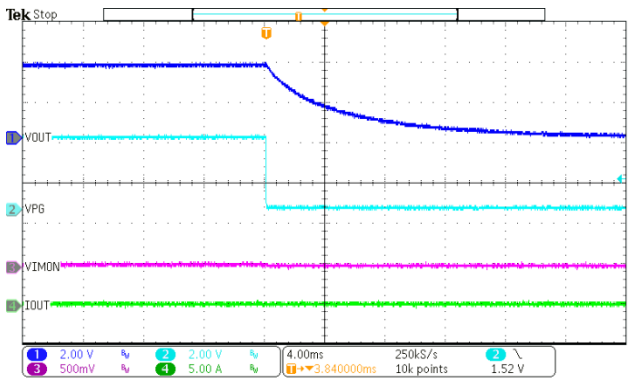
Power Good (En Star Up)

V_{IN}=3.6V, V_{CC}=3.6V, No load



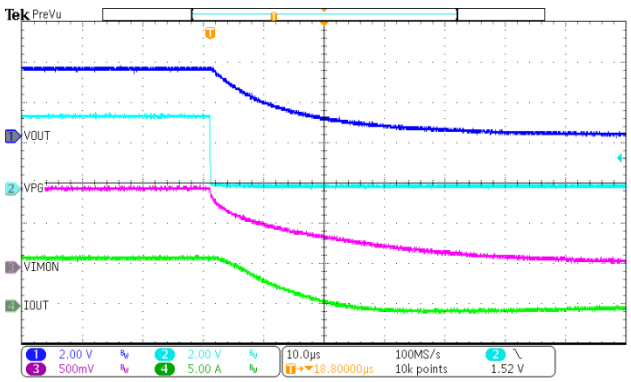
Power Good (En Star Up)

V_{IN}=3.6V, V_{CC}=3.6V, 7A load



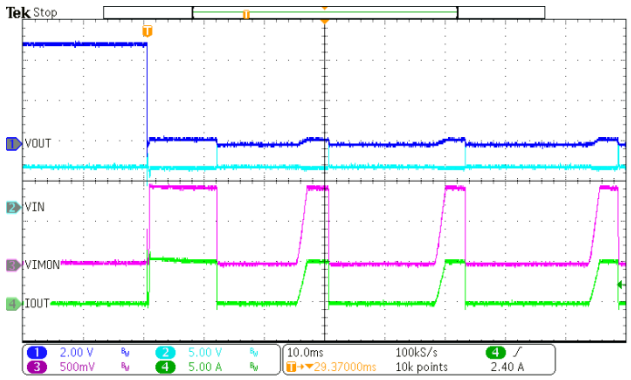
Power Good (En Shutdown)

V_{IN}=3.6V, V_{CC}=3.6V, No load



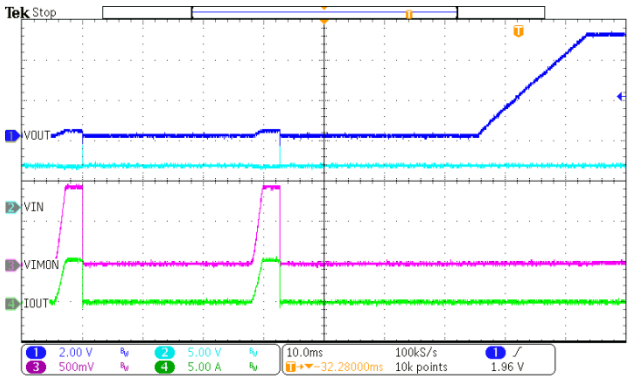
Power Good (En Shutdown)

V_{IN}=3.6V, V_{CC}=3.6V, 7A load



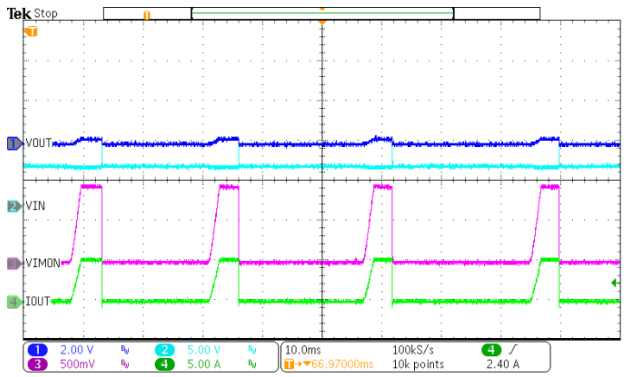
SCP Enter

V_{IN}=5V, V_{CC}=3.3V

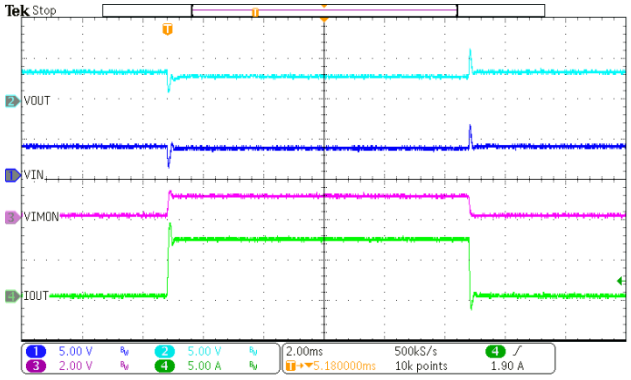


SCP Recover

V_{IN}=5V, V_{CC}=3.3V



SCP Steady State



Load Transient Response

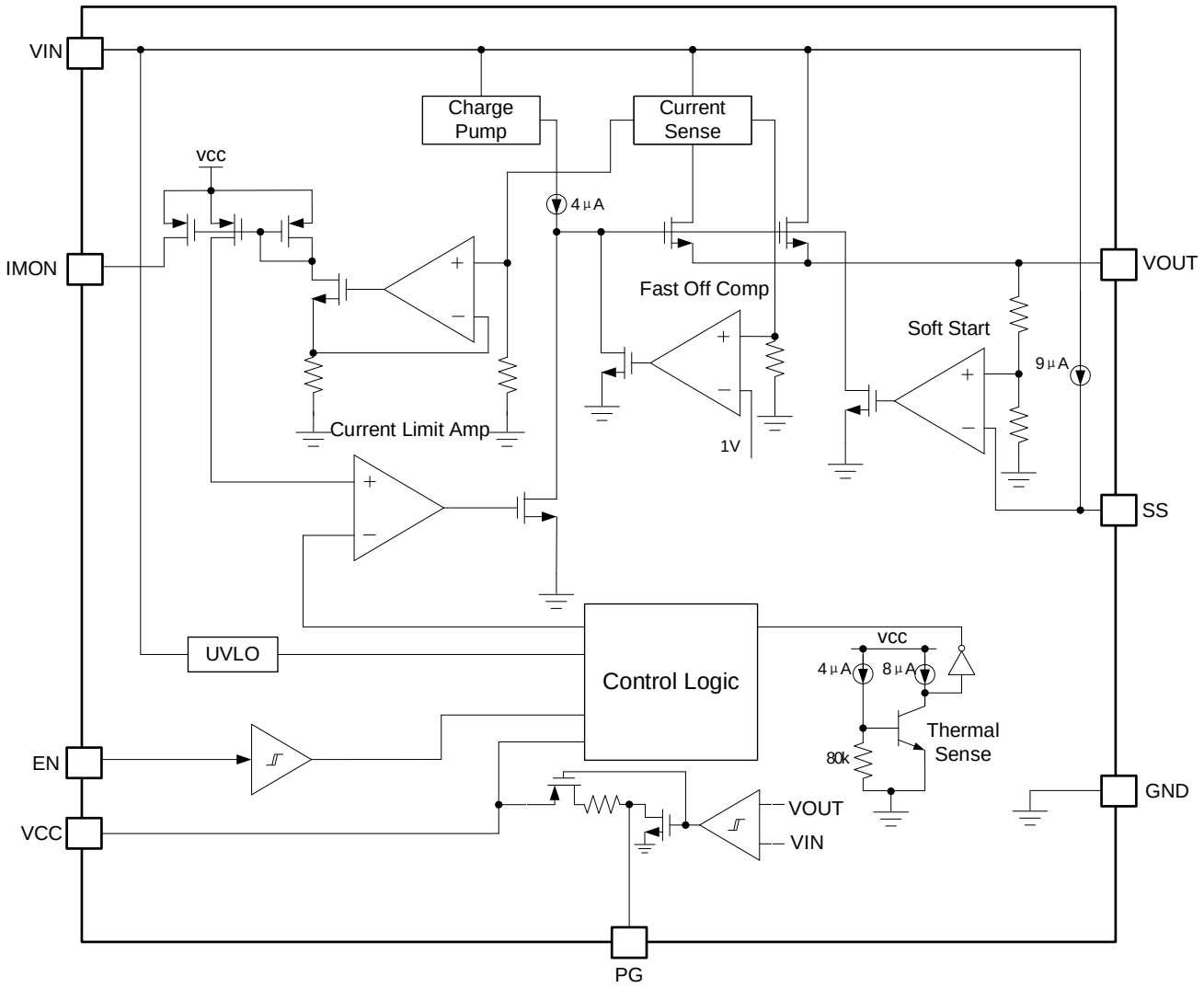
V_{IN}=5V, V_{CC}=3.3V, I_{OUT}= 0A→7A

11. Function Description

11.1 Overview

The WP2706 is designed to limit the in-rush current to the load when a circuit card is inserted into a live backplane power source, thereby limiting the backplane's voltage drop and the slew rate of the voltage to the load. It provides an integrated solution to monitor the input voltage, output voltage and output current to eliminate the need for an external current power MOSFET, and current sense device.

11.2 Block Diagram



11.3 Feature Description

11.3.1 Enable

When input voltage is greater than the undervoltage lockout threshold (UVLO), typically 0.5V, WP2706 can be enabled by pulling EN pin to higher than 1.5V. Pulling down to ground will disable WP2706.

11.3.2 Current Limiting

The WP2706 provides a constant current limit that can be programmed by an external resistor. Once the device reaches its current limit threshold, the internal circuit regulates the gate voltage to hold the current in the power FET constant. The typical response time is about 20μs and the output current may have a small overshoot during this time period. The pre-set current limit value can be calculated by below equation:

$$I_{Limit} = (1 \div R_{IMON}) \times S$$

S is the current sense ratio of WP2706, and this value is typically 82000 in VIN=3.6V. The S is almost a constant value when Vin is changing from 1.2V to 5.5V, and when Vin is smaller than 1.2V, a step change will come to S value, the value will change from 82000 to about 80000. Meanwhile, when Vcc is changing, there is also a little shift on S value, for more information, please refer the curves in typical performance characteristics. If the current limit block starts to regulate the output current, the power loss on power MOSFET will cause the IC temperature rise. If the junction temperature rose to high enough, it will trigger thermal shutdown. After thermal shutdown happened, it will disable the output until the over temperature fault remove. The over temperature threshold is 155°C and hysteresis is 40°C.

11.3.3 Power Good Function

The PG pin is the push pull of a MOSFET that can be pulled high to VCC. The MOSFET turns on with the application of an input voltage so that the PG pin is pulled to GND. After the voltage gap between VIN and VOUT is smaller than 150mV, the PG pin is pulled high after a 90μs delay. When the voltage gap is higher than 200mV, the PG pin will be pulled low. The PG pin has a nominal pull down resistance of 200Ω and a pull-up resistance of 250KΩ.The maximum sink current when the pin is pulled to GND through the internal pull-down resistor should be <10mA

11.3.4 Output Discharge

WP2706 has output discharge function. This function can discharge the VOUT by internal pull down resistance when IC disabled and the load is very light.

11.3.5 Output Discharge

WP2706 has output discharge function. This function can discharge the VOUT by internal pull down resistance when IC disabled and the load is very light.

11.3.6 Soft Start

A capacitor connected to the SS pin determines the soft-start time. There is an internal 9μA constant current source charge SS cap and ramps up the voltage on the SS pin. The output voltage rises at 3 times the slew rate to the SS voltage. The soft-start time can be calculated by below equation:

$$T_{SS}(ms) = \frac{1}{3} \times \frac{V_{OUT}(V) \cdot C_{SS}(nF)}{I_{SS}(\mu A)}$$

T_{SS} is the soft-start time, ISS is internal 9μA constant current, CSS is external soft-start cap.The suggestion minimum SS cap should be bigger than 4.7nF. If the SS pin is floated or SS cap is too small, the VOUT rising time will be just limited by power MOS charge time.

12. Application and Implementation

12.1 Application Information

12.1.1 IMON Resistor Selection

The current limit value can be set by IMON resistor. The current limit threshold is suggested to 10% ~ 20% higher than maximum load current. For example, if the system's full load is 7A, set the current limit to 7.7A.

12.1.2 IMON Capacitor Selection

The internal advanced auto-zero comparator bring a high accuracy of current monitor. The auto-zero will also cause some little jitter on IMON pin. To get a more stable IMON, a small ceramic capacitor can be mounted between IMON and ground. Suggested place an IMON capacitor less than 1nF.

12.1.2 Soft Start Capacitor Selection

There is an internal 9μA constant current source charge SS cap and ramps up the voltage on the SS pin. The output voltage rises follow the slew rate of SS voltage.

If the inrush on output current reached the current limit during start up (like with large output cap or very large load), WP2706 will limit the output current and the same time, SS time will be increased.

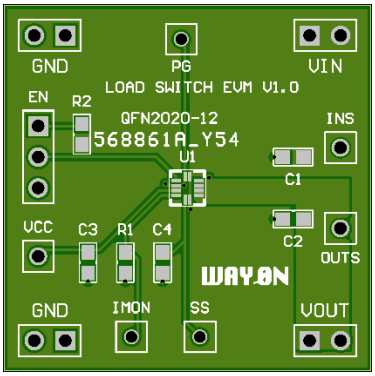
13. Power Supply Recommendations

The device is designed to operate from a VIN range of 0.5 V to 5.5 V. This supply must be well regulated and placed as close to the device terminal as possible with the recommended 44μF bypass capacitor. If the supply is located more than a few inches from the device terminals, additional bulk capacitance may be required in addition to the ceramic bypass capacitors.

14. Layout

For best performance, all traces should be as short as possible, the input and output capacitors should be placed close to the device to minimize the effects that parasitic trace inductances may have on normal and short-circuit operation. The VIN terminal should be bypassed to ground with low ESR ceramic bypass capacitors. The typical recommended bypass capacitance is 44μF ceramic with X5R or X7R dielectric. This capacitor should be placed as close to the device terminals as possible. Using wide traces for VIN, VOUT, and GND will help minimize parasitic electrical effects along with minimizing the case to ambient thermal impedance.

14.1 Layout Example



15. Evaluation Modules

Evaluation Modules (EVMs) are available to help evaluate the device performance. We have evaluation modules for different packages, you can contact us by phone or address at the end to get the evaluation module or schematic.

The module names are listed in the table below. The module names are listed in the table below.

NAME	PACKAGE	EVALUATION MODULE
WP2706	QFN2x2-12	LOAD SWITCH EVM V1.0 QFN2020-12

16. Naming Conventions

WP AB CC- DDD E

WP: WAYON Protection IC;

A: Product Category –2: Load Switch;

B: Maximum Output Current – 7: ＜8A;

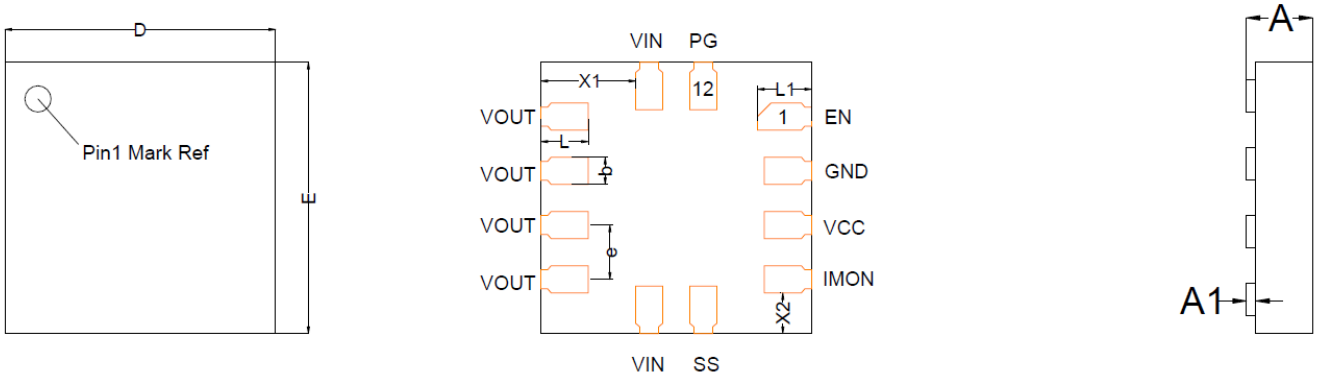
CC: Serial number;

DDD: Package – QFN2x2-12

E: R-Reel & T-tube;

17. Package Information

QFN2x2-12



SYMBOL	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	0.520	0.550	0.580
A1	0.007	0.012	0.017
D	1.950	2.000	2.050
b	0.150	0.200	0.250
L	0.300	0.350	0.400
L1	0.350	0.400	0.450
e	0.350	0.400	0.450
X1	0.650	0.700	0.750
X2	0.250	0.300	0.350

18. Ordering Information

PART NUMBER	CURRENT LIMIT	PACKAGE	PACKING QUANTITY	MARKING*
WP2706QMR	7A	QFN2x2-12	3k/Reel	2706 XXXX

* XXXX is variable.

STATEMENTS

WAY-ON provides data sheets based on the actual performance of the device, and users should verify actual device performance in their specific applications. The device characteristics and parameters in this data sheet can and do vary from application to application, and actual device performance may change over time. This information is intended for developers designing with WAY-ON products. Users are responsible for selecting the appropriate WAY-ON product for their application and for designing and verifying the application to ensure that your application meets the appropriate standards or other requirements, and users are responsible for all consequences. Specifications are subject to change without notice.

Contact Information

No.1001, Shiwan(7) Road, Pudong District, Shanghai, P.R.China.201202
Tel: 86-21-68960674 Fax: 86-21-50757680 Email: market@way-on.com
WAYON website: http://www.way-on.com
For additional information, please contact your local Sales Representative.
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Users should verify actual device performance in their specific applications.